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Iceland, Greenland, &c., I believe also to be a proof that the Gulf Stream sends its waters far to the north.

Among the tropical products frequently found is the bean of the *Mimosa scandens*, one of which I send you, and which I found on the shores of Iceland. Near Husavik (North Iceland) I once picked up on the beach so large and fine a specimen of this mimosa, that I had a snuffbox made of it.

The enclosed description of the currents will show, that Capt. Södring, in the *Fox* (the same vessel which Captain Sir Leopold M'Clintock commanded on the Franklin expedition), on the 7th of March, 1860, in 66° 21' lat. N., and 1° 26' long. W., found the water on its surface, after the long winter's influence in these cold climates, still at 4° R. or 41° Fahrenheit.

With all these facts it appears to me, that the Gulf Stream can be followed through the Northern Atlantic, even up to the Icy Sea.

I have limited myself to the above short report, as many distinguished Fellows of the Royal Geographical Society are so well acquainted with the currents of the ocean, that I find it superfluous to add more circumstantial details concerning this matter.

Most respectfully,

C. IRMINGER,

Rear-Admiral, Royal Danish Navy.

2. *On the Surface Temperature of the North Atlantic, in reference to Ocean Currents.* By NICHOLAS WHITLEY, C.E.

THE thermometrical observations on which this Paper is founded were commenced on the Cornish coast in 1849, and were afterwards extended to the Scilly Isles, the Seven Stones Light-ship, to Yarmouth, and to the Shetland Isles. And, further, in order to ascertain the temperature of the surface water across the Atlantic, extracts were made from the log-books of Cunard's steam-ships sailing between Liverpool and New York, for a period of five years; which have been reduced to monthly means at every five degrees of longitude, and are embodied in the table appended to this Paper.

The primary object was an endeavour to determine the influence of the Gulf Stream on the climate and agriculture of the British Isles.

In this Paper I purpose only to state the general results obtained, and to apply the evidence as a test of the existence of ocean currents.

The chart exhibited to the Meeting shows the surface temperature of the sea taken in five voyages in different years, and similar observations are given in the table at the end of this Paper.

In January the sea around the Scilly Isles is somewhat warmer than on the western coast of Ireland, and there is a decreasing temperature from 51° at the Seven Stones to 42° at Shetland, being a difference of only 9° in 700 miles of latitudinal distance. The January temperature of the water continues also to decrease down the eastern coasts of Scotland and England, until it reaches its minimum of 37° at Great Yarmouth.

We may, therefore, infer that the North Sea in winter derives its warmth rather from the strong tides which pass around the north of Scotland than from any warmer water flowing through the Straits of Dover.

The mean temperature of the sea in Penzance Bay, last January, was 50° , and between Hull and Hamburg 43° . In the same month, on the American coast, the sea is very cold, seldom rising above the freezing-point, and often from two to four degrees below it. The chilling effect of the Arctic current is felt far down the coast; but where the water is somewhat sheltered from its influence by the land of Nova Scotia and Newfoundland it rises several degrees in warmth.

The extent and greatest intensity of the Arctic current is sharply shown by the thermometer in every voyage. The cold water on the banks of Newfoundland reaches its mean monthly minimum of 30° in January, and its mean maximum of 52° in September, and its width is fully 400 British miles.

On the eastern side of the cold current, and in close proximity to it, there is a bed of very warm water having a mean temperature in January of 57° , being 27° warmer than that on the Banks, over a width of about 200 miles. This appears to be a strong eddy of the Gulf Stream, curving northward, and holding the Arctic current in its warm embrace.

From this part of the sea to near the Irish Coast the warmth is more equally distributed through the water, and the thermometer does not detect any well-defined branch of the Gulf Stream flowing to the N.E. There is, however, a decided rise in the temperature about the middle of the Atlantic, amounting to from four to six degrees above that of the sea at Scilly, and the figures on the chart appear to indicate that it lies in a S.W. and N.E. direction. It is most probably the drift of the Gulf Stream driven to the N.E. by the prevailing S.W. wind.

The observations at the coast stations on the west of Ireland

show a temperature of 3° below that of the open sea 350 miles to the west.

Our s.w. wind has its birthplace where the temperature of the sea is at least 55° in January, causing the thermometer on the Cornish coast, under its influence, to stand steadily at 52° , and the great warmth of the past winter resulted from the continued persistency of this wind rather than from any excess of heat in the sea.

The s.w. wind gives to Penzance a mean winter temperature of 44° , being the same as that of Montpellier; Cork falls short of it by only half a degree; and the Scilly Isles at this season exceed this noted winter resort by $2\frac{1}{2}^{\circ}$.

TABLE, showing the Temperature of the Surface-water of the Atlantic Ocean, at every 5° of Longitude, from the South of Ireland to the Banks of Newfoundland, on the course of Cunard's Steam-ships.

Months.	On the Banks.	Longitude West.						
		40°	35°	30°	25°	20°	15°	10°
January	30	57	53	54	55	54	52	51
February	31	54	53	52	53	52	52	50
March	32	54	54	55	54	54	52	51
April	34	57	55	55	52	54	53	52
May	34	55	54	55	56	55	53	53
June	40	60	59	58	56	58	58	57
July	45	60	59	58	59	60	58	59
August	50	61	59	60	59	60	60	59
September	52	59	59	60	59	60	59	58
October	47	59	59	56	56	57	57	55
November	44	58	57	58	59	57	54	53
December	32	55	54	54	54	54	53	52
Mean of the Year	39.2	57.2	56.2	56.2	56.0	56.2	55.1	54.2

Penarth, Truro, April 23rd, 1869.

The PRESIDENT, in returning thanks to the authors of the Papers, said that Admiral Irmingier was a distinguished officer of the Danish navy, well-known for the interest he had taken in Arctic exploration during the time of the search for Sir John Franklin. Our own naval commanders would well recollect the kind services he then rendered them. He (the President) was proud to reckon the gallant Admiral amongst his own personal friends.

Mr. FINDLAY said he believed it an error to call the warm stream which flowed towards the western coasts of Europe the Gulf Stream; and he believed that known facts revealed some larger agent than the Gulf Stream at work in producing the mild climates of Western Europe. It was only within the last twenty years that it had been called the Gulf Stream. Rennell, Herschel, and all the older authorities, called it the North Atlantic current. The Gulf Stream, where it issued from the narrows of the Gulf of Florida, had a sectional area of only six square miles. It took about 220 days to travel from the Gulf

of Florida to the Land's End. At the outset the surface-temperature was $77^{\circ}5'$; at a depth of 1200 feet it was 55° . When it arrived at the Land's End the temperature was 51° . If this stream were continuous, as warm water, the following anomalies would have to be admitted:—Leaving the Straits of Florida in May, it would reach the Land's End in January. After an interval of ten days it arrives off Cape Hatteras, with a loss of 3° of temperature. In forty days it has lost 15° , and in fifty days the temperature is 57° . Further eastward it was 51° , then it got warmer, rising to 65° , and at last it attained an even temperature until it reached the Land's End. Taking the opposite season, the Gulf Stream, at its coldest, was 30° off Newfoundland. A strong and broad current came down from the polar basin, which cut off the northern or warmest edge of the Gulf Stream and neutralised its effects there, so that it was no longer to be called the Gulf Stream. The southern half of the stream travelled down the coast of Portugal, and there, turning to the eastward, passed round the middle basin of the North Atlantic. The quantity of water which passed through the narrows of the Gulf of Florida was 297 cubic miles per day; whereas the area which that water was claimed to cover off Western Europe was a million and a half of square miles, which would give a depth of only six inches of warm water per day. Therefore, it was not alone the Gulf Stream, but the prevalent south-westerly winds which drove the water from warmer latitudes northward to the western coast of Europe. Besides, there was the great Arctic basin, which contains another million and a half of square miles over which the so-called Gulf Stream has to prevail. The truth was, we were very insufficiently informed as to the extent of this great current; we were only at the beginning of our investigations. In our present state of knowledge he (Mr. Findlay) contended it was not the Gulf Stream that reached our shores as an uninterrupted stream of water from the Gulf of Mexico. The drifts which Admiral Irninger mentioned travelled only from one to three miles per diem, and at that rate it would take the Gulf Stream hundreds of years to cover so large an area with warm water.

Captain SHERARD OSBORN quite agreed with Mr. Findlay that it was too soon to make theories about the Atlantic or any other currents. We wanted facts rather than theories. He, however, did not agree in confining the width of the Gulf Stream to the current flowing between the Bahamas and Florida, because warm water flowed up both sides of the Bahamas.

Admiral Sir EDWARD BELCHER objected to the term Gulf Stream, inasmuch as the water which came from the gulf was heated to 86° on the south side of the Caribbean Islands, whereas, as it passed Cape Florida, the temperature was down to 71° . In all parts of the world there were certain currents which had not yet been accounted for. The warm current in its passage northward refused to mingle with the cold Polar current which came down southward, and there was a line of demarcation between them like a wall, so that the bow of a ship, as we learned from the log of Admiral Milne, might be in 46° and the stern in 27° . Those who had been accustomed to navigate off the banks of Newfoundland knew that the result of these two streams meeting was a terrific hurricane. At the present moment he was engaged in ascertaining, from an examination of an immense number of ships' logs, the general temperature of the ocean, with a view to enable sailing ships to select the best period of the year for making their passages. He hoped to be prepared with a paper on the subject at the next meeting of the British Association. For instance, the Pacific was warmer than the Atlantic; for when he was in Behrings' Straits at the time that the temperature off the coast of Ireland was 52° , off Icy Cape, in 70° north, the temperature was 54° . Again, he had ascertained that the temperature between Greenland and the Orkneys did not vary very much.

Colonel EVELYN said he had been struck by the great similarity that existed

between the great oceanic streams and the atmospheric currents above. It might be that they were acted upon by much the same causes. We knew little of the under currents of the ocean, and little of the upper currents of the air. It was the upper current of the ocean and the lower current of the air that principally came under our notice; and it was with difficulty that we obtained an imperfect knowledge of the others by means of aerial expeditions, or laborious deep-sea soundings. But there appeared good reason to believe that the upper and under currents of ocean and atmosphere correspond to a remarkable extent—that the under-currents of the ocean, like those of the air, come from the Poles, and that the upper counter-currents flow back in both cases towards the Poles. The under-currents of the ocean are, in fact, analogous to the trade-winds, and the surface-currents to the reflux of the trade-winds, which, descending to the earth in high latitudes, cause our prevailing south-west winds. The water, like the air, must also be affected by the difference in the rotatory velocity of the earth's surface depending on the latitude. This must give to Polar currents, either of air or water, an apparent westerly direction, and to Equatorial currents an easterly one.

Colonel Evelyn, in conclusion, pointed out the anomaly of calling a current of air coming from the east an easterly wind, whilst a stream of water coming from the same direction was usually called a westerly current. These anomalous terms increased the difficulty he experienced in offering a few impromptu remarks about currents of air and currents of water.

Admiral OMMANNEY reminded the meeting that bottles thrown overboard in the West Indies had been picked up on the coast of Norway. He mentioned this fact as strong evidence of the course of the Gulf Stream.

Sir ANDREW WAUGH was surprised that no notice had been taken of an admirable work by Mr. Croll, in which he entered into the physical question of the latent heat absorbed by water. The effect of his book was to show that the hot water coming from the Gulf Stream was quite sufficient to carry a body of latent heat to influence our climate.

Mr. FINDLAY admitted the pains taken by Mr. Croll, but it seemed to him that that gentleman had doubled the quantity of water which came out of the Gulf, and he took no account of the period which it took the Gulf Stream to reach its point of parting, nor of the great mass of cold water which poured down into it on its northern edge and there neutralised it. It was a question for geologists whether the shoals off Newfoundland were not formed by the antagonistic action of the Gulf Stream and the Polar current at that particular part.

Dr. RAE said he had studied the action of rivers as affecting the temperature of water, and he had heard from distinguished men in the navy and merchant service that the influence of the large rivers of South America, such as the Amazons, was felt one and two hundred miles at sea. He computed the body of the Gulf Stream to be fifty times as large as the Amazon or the Rio Plata, and if that was right the influence of the Gulf Stream would account for the warm currents which flowed upon the western coasts of Europe. The cold current which was met at Newfoundland would deflect the Gulf Stream, or if the cold water penetrated it, the warm water, being lighter, would rise above it. With reference to what Admiral Ommanney had said, he himself knew that in the Orkneys fruits and plants had been picked up which only grew in the West Indies. The influence of the warm current was so strongly felt there that he adhered to the old theory of the Gulf Stream. He had calculated that the Gulf Stream brought over to our coasts a body of warm water eight or ten fathoms deep, and 400 miles in width, which, flowing in a south-westerly direction along with our warmest winds, gives a very large heating surface.

Admiral Sir EDWARD BELCHER said, with regard to drift, within this year two sea substances which existed about Teneriffe had been blown ashore at Torquay, and within the last week a Portuguese man-of-war, or *Physalia*, had been cast ashore at the same place.

3. *On Open Water in the Polar Basin.* By Captain

R. V. HAMILTON, R.N.

THE idea of an open sea and milder climate in the vicinity of the Pole has, at all events, the merit of antiquity to recommend it, and has been adopted on scientific grounds by many of our modern eminent geographers—amongst them Maury, who endeavours to support the conclusions arrived at theoretically, by arguments drawn from modern Arctic explorers, and the celebrated drifts of the *Advance*, *Resolute*, and *Fox*. It would, indeed, be presumptuous on my part to dispute the justness of the scientific deductions of so eminent a philosopher; but, having the practical experience of two Arctic voyages, I trust to show the deductions he has drawn from the accounts of voyages are erroneous, and would not have been drawn had his personal experience of ice-movements been equal to his scientific knowledge.

Maury's arguments* may be briefly expressed as follows:—

1. He infers† that a warm under current sets through Baffin's Bay into the Polar basin, and eventually rises to the surface and ameliorates the climate.

2. On the indications of a milder climate as shown by the migration of birds.‡

3. On the open sea seen by Penny and Kane in Wellington and Kennedy channels,§ and an erroneous idea that Kane procured subsistence for his party on the borders of this "ice-bound sea."

4. On the assumption that the drifts of the *Fox* and *Advance* were caused by "a tongue of ice 1000' long, coming out of the Polar sea formed at the edge of open water in it."||

It would extend beyond the limits of a paper to give full quotations from Maury: I will, therefore, endeavour to convey his meaning; and as it is principally with the last argument I intend to deal I shall reply very briefly to the three first.

He infers¶ from the very exceptional case of icebergs having been seen drifting north, that an under current exists which must come from the tropics, and is therefore warm.

* Eighth edition, 1861. † Pars. 424-484. ‡ *Ib.* 425. § *Ib.* 428-432.
 || *Ib.* 431, 476-8. ¶ *Ib.* 424.